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NATIONAL EUTROPHICATION SURVEY

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REPORT
ON
BLUEWATER LAKE
MCKINLEY AND VALENCIA COUNTIES
NEW MEXICO
EPA REGION VI
WORKING PAPER No. 818

WITH THE COOPERATION OF THE
NEW MEXICO ENVIRONMENTAL IMPROVEMENT AGENCY
AND THE
NEW MEXICO NATIONAL GUARD
JULY 1977

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16. ABSTRACT
Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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REPORT ON BLUEWATER LAKE

MCKINLEY AND VALENCIA COUNTIES, NEW MEXICO

EPA REGION VI

by

National Eutrophication Survey

Water and Land Quality Branch
Monitoring Operations Division
Environmental Monitoring & Support Laboratory
Las Vegas, Nevada

and

Special Studies Branch
Corvallis Environmental Research Laboratory
Corvallis, Oregon

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U.S. ENVIRONMENTAL PROTECTION AGENCY

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point source discharge reduction and nonpoint source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by the U.S. Environmental Protection Agency and to augment plans implementation by the states.

ACKNOWLEDGMENTS

The staff of the National Eutrophication Survey (Office of Research and Development, U.S. Environmental Protection Agency) expresses sincere appreciation to the New Mexico Environmental Improvement Agency for professional involvement, to the New Mexico National Guard for conducting the tributary sampling phase of the Survey, and to those New Mexico wastewater treatment plant operators who provided effluent samples and flow data.

The staff of the Surveillance Section, Water Quality Division, New Mexico Environmental Improvement Agency provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports and provided critiques most useful in the preparation of this Working Paper Series.

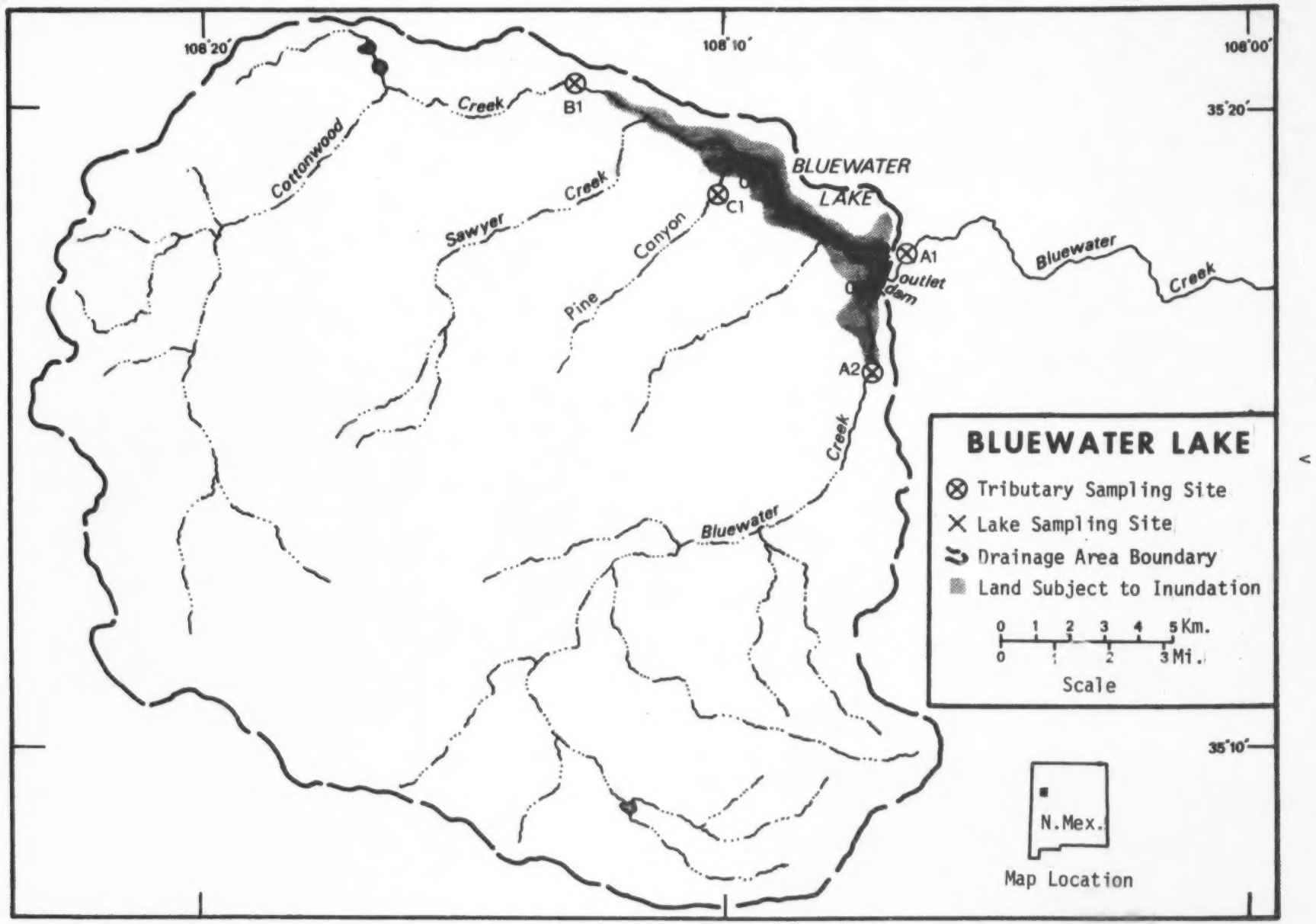
Brigadier General Franklin E. Miles, the Adjutant General of New Mexico, and Project Officer Colonel Marvin D. Bohannon, who directed the volunteer efforts of the New Mexico National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF NEW MEXICO

LAKE NAME	COUNTY
Alamogordo Reservoir (Sumner Lake)	De Baca, Guadalupe
Bluewater Lake	Valencia, McKinley
Conchas Reservoir	San Miguel
Eagle Nest Lake	Colfax
Elephant Butte Reservoir	Sierra
El Vado Reservoir	Rio Arriba
Lake McMillan	Eddy
Ute Reservoir	Quay


108°20'
108°10'
108°00'
35°20'
35°10'
B1
C1
A1
A2
BLUEWATER
LAKE
Outlet
dam
Cottonwood
Creek
Sawyer
Creek
Pine
Canyon
Creek
Bluewater
Creek
Bluewater
BLUEWATER LAKE
Tributary Sampling Site
Lake Sampling Site
Drainage Area Boundary
Land Subject to Inundation
0 1 2 3 4 5 Km.
0 1 2 3 Mi.
Scale
N.Mex.
Map Location

REPORT ON BLUEWATER LAKE, NEW MEXICO

STORET NO. 3502

I. CONCLUSIONS

A. Trophic Condition:*

Survey data indicate that Bluewater Lake is meso-eutrophic. Chlorophyll a values in the lake ranged from 1.6 µg/l to 7.2 µg/l with a mean of 3.9 µg/l. The potential for primary productivity as measured by algal assay control yields was high on the May sampling date and low during the October sampling. Lake water transparency was low. Of the nine New Mexico lakes (including Navajo Reservoir) sampled in 1975, three had higher median total phosphorus values (0.036 mg/l), none had higher median inorganic nitrogen levels (0.140 mg/l), and three had higher median ortho-phosphorus values (0.012 mg/l) than Bluewater Lake.

Survey limnologists did not report any algal blooms or macrophyte problems during their visits to the lake. However, low Secchi disc readings (range of 0.3 to 0.9 meters) suggest that light limitation may be affecting primary productivity. Other sources (New Mexico Water Quality Control Commission, 1975) report that blue-green algal blooms have been recorded in the lake.

*See Appendix E.

B. Rate-Limiting Nutrient:

The algal assay results indicate that Bluewater Lake was limited by available phosphorus during both sample collection times (05/05/75, 10/01/75). Lake data suggest nitrogen limitation in the spring and summer and phosphorus limitation in the fall.

C. Nutrient Controllability:

1. Point sources -

There were no known point sources impacting Bluewater Lake during the sampling year. The present phosphorus loading of 0.08 $g/m^2/yr$ is slightly less than that proposed by Vollenweider as "oligotrophic" for a lake of such volume and hydraulic retention time.

2. Nonpoint sources -

Nonpoint sources, including precipitation, contributed all of the calculated phosphorus load to Bluewater Lake during the sampling year. Cottonwood Creek contributed 34.7%, Bluewater Creek contributed 19.5%, and ungaged tributaries contributed an estimated 22.9% of the total.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

Lake and drainage basin characteristics are itemized below. Lake morphometry data were provided by Martin and Hanson (1966) and Tony Drypolcher (personal communication). Tributary flow data were provided by the New Mexico District Office of the U.S. Geological Survey (USGS). Outlet drainage area includes the lake surface area. Mean hydraulic retention time was obtained by dividing the lake volume by mean flow of the outlet. Precipitation values are estimated by methods as outlined in National Eutrophication Survey (NES) Working Paper No. 175. A table of metric/English conversions is included as Appendix A.

A. Lake Morphometry:

1. Surface area: 7.07 km^2.
2. Mean depth: 6.7 meters.
3. Maximum depth: 17.4 meters.
4. Volume: 47.489 x 10^6 m^3.
5. Mean hydraulic retention time: 2,114 days (5.8 yr)

B. Tributary and Outlet:
(See Appendix B for flow data)

1. Tributaries -

Name	Drainage area (km^2)	Mean Flow (m^3/sec)
A-2 Bluewater Creek	195.3	0.09
B-1 Cottonwood Creek	167.8	0.09
C-1 Unnamed Stream	15.8	0.01
Minor tributaries and immediate drainage -	135.6	0.07
Total	514.5	0.26
2. Outlet - A-1 Bluewater Creek	520.6	0.26

C. Precipitation:

1. Year of sampling: 37.7 cm.
2. Mean annual: 31.3 cm.

III. LAKE WATER QUALITY SUMMARY

Bluewater Lake was sampled three times during the open-water season of 1975 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from three stations on the lake and from a number of depths at each station (see map, page v). During each visit, depth-integrated samples were collected from each station for chlorophyll *a* analysis and phytoplankton identification and enumeration. During the first and last visits, 18.9-liter depth-integrated samples were composited for algal assays. Maximum depths sampled were 13.7 meters at Station 01, 7.6 meters at Station 02, and 7.0 meters at Station 03. For a more detailed explanation of NES methods, see NES Working Paper No. 175.

The results obtained are presented in full in Appendix C and are summarized in III-A for waters at the surface and at the maximum depth for each site. Results of the phytoplankton counts and chlorophyll *a* determinations are included in III-B. Results of the limiting nutrient study are presented in III-C.

WATER LAKE
NET CODE 3502

PHYSICAL AND CHEMICAL CHARACTERISTICS

PARAMETER	(5/ 5/75) S*** = 3 N*	RANGE	MEDIAN	MAX DEPTH RANGE (METERS)	(8/19/75) S*** = 3 N*	RANGE	MEDIAN	MAX DEPTH RANGE (METERS)	(10/ 1/75) S*** = 3 N*	RANGE	MEDIAN	MAX DEPTH RANGE (METERS)
TEMPERATURE (DEG CENT)												
0.-1.5 M DEPTH	6	9.5- 10.0	9.7	0.0- 1.5	6	16.5- 17.0	16.8	0.0- 1.5	6	16.2- 16.6	16.3	0.0- 1.5
MAX DEPTH**	3	9.3- 9.5	9.3	7.0- 13.7	3	16.4- 16.4	16.4	4.6- 12.2	3	16.1- 16.3	16.1	4.3- 11.3
DISSOLVED OXYGEN (MG/L)												
0.-1.5 M DEPTH	5	7.8- 8.2	7.8	0.0- 1.5	6	5.6- 7.8	6.6	0.0- 1.5	6	6.2- 8.0	6.7	0.0- 1.5
MAX DEPTH**	3	7.4- 8.0	7.4	7.0- 13.7	3	3.6- 6.2	5.4	4.6- 12.2	3	6.4- 7.0	6.5	4.3- 11.3
CONDUCTIVITY (UMHOS)												
0.-1.5 M DEPTH	6	332.- 353.	347.	0.0- 1.5	6	385.- 392.	386.	0.0- 1.5	6	324.- 327.	325.	0.0- 1.5
MAX DEPTH**	3	342.- 352.	347.	7.0- 13.7	3	385.- 394.	385.	4.6- 12.2	3	324.- 325.	325.	4.3- 11.3
PH (STANDARD UNITS)												
0.-1.5 M DEPTH	6	7.8- 8.3	8.0	0.0- 1.5	6	8.3- 8.7	8.6	0.0- 1.5	6	8.3- 8.4	8.3	0.0- 1.5
MAX DEPTH**	3	7.6- 8.1	8.0	7.0- 13.7	3	8.4- 8.6	8.5	4.6- 12.2	3	8.4- 8.4	8.4	4.3- 11.3
TOTAL ALKALINITY (MG/L)												
0.-1.5 M DEPTH	6	112.- 116.	115.	0.0- 1.5	6	123.- 130.	127.	0.0- 1.5	6	146.- 149.	148.	0.0- 1.5
MAX DEPTH**	3	115.- 116.	115.	7.0- 13.7	3	123.- 133.	125.	4.6- 12.2	3	147.- 150.	147.	4.3- 11.3
TOTAL P (MG/L)												
0.-1.5 M DEPTH	6	0.029-0.041	0.030	0.0- 1.5	6	0.029-0.055	0.036	0.0- 1.5	6	0.033-0.052	0.037	0.0- 1.5
MAX DEPTH**	3	0.032-0.044	0.033	7.0- 13.7	3	0.033-0.073	0.038	4.6- 12.2	3	0.036-0.050	0.037	4.3- 11.3
DISSOLVED ORTHO P (MG/L)												
0.-1.5 M DEPTH	6	0.009-0.016	0.012	0.0- 1.5	6	0.004-0.009	0.006	0.0- 1.5	6	0.011-0.016	0.012	0.0- 1.5
MAX DEPTH**	3	0.013-0.014	0.014	7.0- 13.7	3	0.007-0.034	0.010	4.6- 12.2	3	0.012-0.016	0.012	4.3- 11.3
NO2+NO3 (MG/L)												
0.-1.5 M DEPTH	5	0.080-0.120	0.085	0.0- 1.5	6	0.020-0.030	0.020	0.0- 1.5	6	0.050-0.050	0.050	0.0- 1.5
MAX DEPTH**	3	0.080-0.100	0.100	7.0- 13.7	3	0.020-0.310	0.030	4.6- 12.2	3	0.040-0.050	0.050	4.3- 11.3
AMMONIA (MG/L)												
0.-1.5 M DEPTH	6	0.040-0.100	0.055	0.0- 1.5	6	0.020-0.050	0.035	0.0- 1.5	6	0.190-0.220	0.195	0.0- 1.5
MAX DEPTH**	3	0.040-0.080	0.080	7.0- 13.7	3	0.050-0.200	0.070	4.6- 12.2	3	0.190-0.210	0.200	4.3- 11.3
KJELDAHL N (MG/L)												
0.-1.5 M DEPTH	6	0.600-0.800	0.750	0.0- 1.5	6	0.400-0.700	0.450	0.0- 1.5	6	0.600-0.900	0.800	0.0- 1.5
MAX DEPTH**	3	0.600-0.600	0.600	7.0- 13.7	3	0.400-0.600	0.400	4.6- 12.2	3	0.700-0.900	0.800	4.3- 11.3
SECCHI DISC (METERS)	3	0.5- 0.9	0.5		2	0.4- 0.9	0.7		3	0.3- 0.3	0.3	

* N = NO. OF SAMPLES
** MAXIMUM DEPTH SAMPLED AT EACH SITE
*** S = NO. OF SITES SAMPLED ON THIS DATE

B. Biological Characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units Per ml
05/05/75	1. Flagellate	570
	2. Cyclotella	342
	3. Chroomonas ?	171
	4. Schroederia	171
	5. Chlamydomonas	114
	Other genera	229
	Total	1,597
08/19/75	1. Aphanizomenon	1,213
	2. Chlamydomonas	152
	3. Chroomonas ?	152
	4. Cryptomonas	114
	5. Cyclotella	76
	Other genera	74
	Total	1,781
10/01/75	1. Chroomonas ?	432
	2. Aphanizomenon	351
	3. Cryptomonas	54
	Other genera	--
	Total	837

2. Chlorophyll *a* -

Sampling Date	Station Number	Chlorophyll *a* (µg/l)
05/05/74	01	1.6
	02	3.6
	03	1.6
08/19/75	01	7.2
	02	3.5
	03	4.7
10/01/75	01	2.9
	02	6.0
	03	3.7

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum Yield (mg/l-dry wt.)
a. 05/05/75			
Control	0.010	0.125	1.2
0.05 P	0.060	0.125	4.9
0.05 P + 1.0 N	0.060	1.125	30.1
1.00 N	0.010	1.125	1.1
b. 10/01/75			
Control	0.005	0.230	0.2
0.05 P	0.055	0.230	4.5
0.05 P + 1.0 N	0.055	1.230	8.7
1.00 N	0.005	1.230	0.2

2. Discussion -

The control yields of the assay alga, Selenastrum capricornutum, indicate that the potential for primary productivity in Bluewater Lake was high during the May sampling (05/05/75) and low during the October sampling (10/01/75). In both assays the addition of phosphorus alone and in combination with nitrogen produced a significant increase in growth over control yields, indicating phosphorus limitation. Spikes of only nitrogen did not produce a growth response beyond that of the control.

The mean inorganic nitrogen to orthophosphorus ratios (N/P) in the lake data were 11/1, 12/1, and 19/1 in the spring, summer, and fall, respectively, suggesting primary limitation by nitrogen in the spring and summer and phosphorus limitation in the fall (a mean N/P ratio of 14/1 or greater generally reflects phosphorus limitation).

IV. NUTRIENT LOADINGS
(See Appendix D for data)

For the determination of nutrient loadings, the New Mexico National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff months of April and May when two samples were collected. Sampling was begun in December 1974, and was completed in November 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the New Mexico District Office of the USGS for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a USGS computer program for calculating stream loadings. Nutrient loads indicated for tributaries are those measured minus known point source loads, if any.

Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of USGS) were estimated by using the mean annual nutrient loads, in $kg/km^2/year$, in Bluewater Creek, Cottonwood Creek, and Unnamed Stream, at Stations A-2, B-1, and C-1 and multiplying the means by the ZZ area in km^2.

A. Waste Sources:

1. Known municipal - None

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (nonpoint load) -		
A-2 Bluewater Creek	115	19.5
B-1 Cottonwood Creek	205	34.7
C-1 Unnamed Stream	10	1.7
b. Minor tributaries and immediate drainage (nonpoint load) -	135	22.9
c. Known municipal STP's - None		
d. Septic tanks* -	<5	<0.1
e. Known industrial - None		
f. Direct precipitation** -	125	21.2
Total	590	100.0%

2. Outputs - A-1 Bluewater Creek 475

3. Net annual P accumulation - 115

*Estimate based on 1 lakeshore residence and 1 park.
**Estimated (See NES Working Paper No. 175).

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source		kg N/yr	% of total
a.	Tributaries (nonpoint load) -		
	A-2 Bluewater Creek	2,245	15.3
	B-1 Cottonwood Creek	2,580	17.6
	C-1 Unnamed Stream	265	1.8
b.	Minor tributaries and immediate drainage (nonpoint load) -	1,900	13.0
c.	Known municipal STP's - None		
d.	Septic tanks* -	45	0.3
e.	Known industrial - None		
f.	Direct precipitation** -	7,630	52.0
	Total	14,665	100.0%

2. Outputs - A-1 Bluewater Creek 9,350

3. Net annual N accumulation - 5,315

*Estimate based on 1 lakeshore residence and 1 park.
**Estimated (See NES Working Paper No. 175).

D. Mean Annual Nonpoint Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
Bluewater Creek	1	11
Cottonwood Creek	1	15
Unnamed Stream	1	17

E. Yearly Loadings:

In the following table, the existing phosphorus annual loading is compared to the relationship proposed by Vollenweider (1975). Essentially, his "eutrophic" loading is that at which the receiving waters would become eutrophic or remain eutrophic; his "oligotrophic" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A "mesotrophic" loading would be considered one between eutrophic and oligotrophic.

Note that Vollenweider's model may not apply to lakes with short hydraulic retention times or in which light penetration is severely restricted by high concentrations of suspended solids in the surface waters.

	Total Yearly Phosphorus Loading (g/m^2/yr)
Estimated loading for Bluewater Lake	0.08
Vollenweider's "eutrophic" loading	0.22
Vollenweider's "oligotrophic" loading	0.11

V. LITERATURE REVIEWED

Drypolcher, Tony. 1975. Personal communication (lake morphometry). New Mexico Environmental Improvement Agency, Santa Fe, New Mexico.

Martin, R. O. R., and R. L. Hanson. 1966. Reservoirs in the United States. Geological Survey Water Supply Paper 1838. United States Department of Interior, Geological Survey, Washington, D.C.

New Mexico Water Quality Control Commission. 1975. Water Quality in New Mexico. Santa Fe, New Mexico.

U.S. Environmental Protection Agency. 1975. National Eutrophication Survey Methods 1973-1976. Working Paper No. 175. National Environmental Research Center, Las Vegas, Nevada, and Pacific Northwest Environmental Research Laboratory, Corvallis, Oregon.

Vollenweider, R. A. 1975. Input-Output Models With Special Reference to the Phosphorus Loading Concept in Limnology. Schweiz. Z. Hydrol. 37:53-84.

VI. APPENDICES

APPENDIX A

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX B

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR NEW MEXICO 12/16/76

LAKE CODE 3502 BLUE WATER LAKE

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 520.6

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEA
3502A1	520.6	0.013	0.133	0.227	0.360	0.227	0.071	0.595	0.821	0.204	0.368	0.113	0.014	0.26
3502A2	195.3	0.007	0.045	0.076	0.122	0.076	0.028	0.190	0.283	0.082	0.125	0.037	0.007	0.09
3502B1	167.8	0.003	0.048	0.079	0.127	0.082	0.020	0.204	0.278	0.059	0.122	0.042	0.003	0.09
3502C1	15.8	0.000	0.003	0.007	0.012	0.005	0.002	0.028	0.031	0.006	0.013	0.003	0.000	0.00
3502ZZ	142.7	0.003	0.037	0.062	0.099	0.062	0.019	0.161	0.224	0.057	0.099	0.031	0.004	0.01

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 520.6
SUM OF SUB-DRAINAGE AREAS = 521.6
TOTAL FLOW IN = 3.12
TOTAL FLOW OUT = 3.15

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3502A1	12	74	0.068	7	0.068				
	1	75	0.062	19	0.062				
	2	75	0.062	9	0.062				
	3	75	0.071	21	0.079				
	4	75	0.142	8	0.125	29	0.204		
	5	75	0.765	22	0.934	31	1.076		
	6	75	1.133	7	1.161				
	7	75	0.850	27	0.736				
	8	75	0.680	29	0.651				
	9	75	0.623	14	0.623				
	10	75	0.595	18	0.566				
	11	75	0.538	15	0.538				
3502A2	12	74	0.025	7	0.031				
	1	75	0.028	19	0.031				
	2	75	0.091	9	0.037				
	3	75	0.623	21	0.680				
	4	75	1.246	8	1.388	29	1.076		
	5	75	0.396	22	0.159	31	0.105		
	6	75	0.054	7	0.071				
	7	75	0.025	27	0.027				
	8	75	0.028	29	0.042				
	9	75	0.028	14	0.028				
	10	75	0.028	18	0.028				
	11	75	0.028	15	0.028				

TRIBUTARY FLOW INFORMATION FOR NEW MEXICO 12/15/76

LAKE CODE 3502 BLUE WATER LAKE

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
350281	12	74	0.020	7	0.024				
	1	75	0.024						
	2	75	0.079						
	3	75	0.538						
	4	75	1.076	8	1.189	29	0.934		
	5	75	0.340	22	0.136	31	0.091		
	6	75	0.045	7	0.059				
	7	75	0.022	27	0.023				
	8	75	0.024						
	9	75	0.0	14	0.0				
	10	75	0.0	18	0.0				
	11	75	0.0	15	0.0				
3502C1	12	74	0.002						
	1	75	0.002						
	2	75	0.007						
	3	75	0.051	21	0.057				
	4	75	0.102	8	0.113				
	5	75	0.031						
	6	75	0.004	7	0.006				
	7	75	0.002	27	0.002				
	8	75	0.002	29	0.003				
	9	75	0.0	14	0.0				
	10	75	0.0	18	0.0				
	11	75	0.0	15	0.0				

APPENDIX C

PHYSICAL AND CHEMICAL DATA

STORET RETRIEVAL DATE 76/12/16
NATL EUTROPHICATION SURVEY
EPA-LAS VEGAS

350201
35 17 33.0 108 06 43.0 3
BLUE WATER LAKE
35061 NEW MEXICO

/TYPA/AMBNT/LAKE

11EPALES 04001002
0049 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/05	10 10	0000	10.0	7.8	34	353	8.30	115	0.100	0.800	0.120	0.016
	10 10	0005	10.0	8.2		348	8.00	115	0.060	0.800	0.090	0.012
	10 10	0015	10.3	8.0		367	8.00	113	0.050	0.600	0.080	0.013
	10 10	0045	9.3	7.4		352	8.00	116	0.080	0.600	0.100	0.014
75/08/19	11 40	0000	16.9	7.8	36	385	8.25	127	0.030	0.700	0.020K	0.006
	11 40	0005	17.0	7.0		387	8.70	126	0.030	0.500	0.020K	0.004
	11 40	0015	16.7	5.6		386	8.50	126	0.050	0.500	0.020K	0.007
	11 40	0040	16.4	5.4		385	8.55	125	0.070	0.400	0.030	0.010
75/10/01	13 40	0000	16.3	6.6	12	327	8.25	146	0.190	0.600	0.050	0.013
	13 40	0005	16.2	6.6		325	8.30	148	0.190	0.700	0.050	0.012
	13 40	0015	16.2	6.8		326	8.35	148	0.190	0.700	0.050	0.012
	13 40	0037	16.1	6.4		325	8.40	147	0.190	0.700	0.050	0.012

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT RFMNING PERCENT
75/05/05	10 10	0000	0.031	1.6	
	10 10	0005	0.029		
	10 10	0015	0.013		
	10 10	0045	0.033		
75/08/19	11 40	0000	0.034	7.2	
	11 40	0005	0.029		
	11 40	0015	0.030		
	11 40	0040	0.038		
75/10/01	13 40	0000	0.038	2.9	
	13 40	0005	0.036		
	13 40	0015	0.032		
	13 40	0037	0.036		

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 76/12/16
NATL EUTROPHICATION SURVEY
EPA-LAS VEGAS

350202
35 18 41.0 108 08 46.0 3
BLUE WATER LAKE
35031 NEW MEXICO
120991

/TYPA/AMBNT/LAKE

11EPALES 04001002
0029 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/05	10 35	0000	9.6	8.2	18	340	8.00	112	0.050	0.800	0.080	0.009
	10 35	0005	9.9	7.8		332	7.80	114	0.040	0.600	0.040	0.010
	10 35	0015	9.9	7.8		350	8.20	115	0.040	0.400	0.070	0.010
	10 35	0025	9.3	7.4		347	7.60	115	0.080	0.600	0.100	0.014
75/08/19	11 00	0000	16.9	6.6	17	392	8.65	129	0.040	0.500	0.020	0.009
	11 00	0005	16.8	6.5		388	8.60	130	0.020K	0.400	0.020K	0.004
	11 00	0015	16.4	3.6		394	8.40	133	0.200	0.600	0.310	0.034
75/10/01	14 00	0000	16.6	8.0	12	325	8.35	148	0.190	0.800	0.050	0.011
	14 00	0005	16.3	6.8		325	8.40	149	0.200	0.800	0.050	0.012
	14 00	0015	16.3	7.0		325	8.40	147	0.200	0.800	0.050	0.012

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT RFMNING PERCENT
75/05/05	10 35	0000	0.038	3.6	
	10 35	0005	0.041		
	10 35	0015	0.037		
	10 35	0025	0.044		
75/08/19	11 00	0000	0.055	3.5	
	11 00	0005	0.039		
	11 00	0015	0.073		
75/10/01	14 00	0000	0.037	6.0	
	14 00	0005	0.033		
	14 00	0015	0.037		

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 76/12/16
NATL EUTROPHICATION SURVEY
EPA-LAS VEGAS

350203
35 17 09.0 108 06 57.0 3
BLUE WATER LAKE
35061 NEW MEXICO

120991

/TYPA/AMBNT/LAKE

11EPALES 04001002
0027 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/05	11 00	0000	9.5	7.8	18	346	7.80	116	0.070	0.700	0.100	0.016
	11 00	0005	9.5			351	8.20	114	0.040	0.600	0.080	0.012
	11 00	0015	9.4			351	8.20	115	0.040	0.600	0.080	0.013
	11 00	0023	9.5	8.0		342	8.10	115	0.040	0.600	0.080	0.013
75/08/19	11 20	0000	16.7	6.6		385	8.60	124	0.050	0.400	0.030	0.007
	11 20	0005	16.5	5.6		385	8.65	123	0.050	0.400	0.020K	0.007
	11 20	0015	16.4	6.2		385	8.65	123	0.050	0.400	0.020K	0.007
75/10/01	14 15	0000	16.3	7.0	12	324	8.40	149	0.200	0.800	0.050	0.014
	14 15	0005	16.3	6.2		325	8.35	147	0.220	0.900	0.050	0.016
	14 15	0014	16.1	6.5		324	8.40	150	0.210	0.900	0.040	0.016

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PRCENT
75/05/05	11 00	0000	0.030	1.6	
	11 00	0005	0.030		
	11 00	0015	0.030		
	11 00	0023	0.032		
75/08/19	11 20	0000	0.044	4.7	
	11 20	0005	0.034		
	11 20	0015	0.033		
75/10/01	14 15	0000	0.052	3.7	
	14 15	0005	0.049		
	14 15	0014	0.050		

K VALUE KNOWN TO BE LESS
THAN INDICATED

APPENDIX D

TRIBUTARY AND WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 76/12/16
NATL EUTROPHICATION SURVEY
EPA- LAS VEGAS

3502A1
35 17 31.0 10A 06 40.0 4
BLUEWATER CREEK
35 7.5 PREWITT
0/BLUE WATER LAKE 120991
RNK 500 FT S END DRT RD 7 M SW RT 66 JCT
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/12/07	11 50		0.016	1.000	0.025	0.010	0.010
75/01/19	10 30		0.060	0.650	0.032	0.010	0.025
75/02/09	11 10		0.016	1.000	0.016	0.010	0.030
75/03/21	11 20		0.030	0.650	0.037	0.040	0.170
75/04/08	11 15		0.065	3.150	0.045	0.005	0.040
75/04/29	10 10		0.030	2.000	0.040	0.005K	0.010K
75/05/22	11 45		0.030	0.900	0.015	0.010	0.310
75/05/31	13 30		0.030	0.650	0.020	0.015	0.070
75/06/07			0.005	1.050	0.075	0.005	0.030
75/07/27	10 15		0.150	1.250	0.100	0.015	0.080
75/08/29	12 25		0.030	0.800	0.090	0.010	0.030
75/09/14	12 00		0.030	1.300	0.220	0.040	0.100
75/10/18	12 30		0.005	0.200	0.030	0.005	0.010
75/11/15	21 00		0.025	0.600	0.005	0.005	0.020

K VALUE KNOWN TO BE LESS THAN INDICATED

STORET RETRIEVAL DATE 76/12/16
NATL EUTROPHICATION SURVEY
EPA- LAS VEGAS

3502A2
35 15 50.0 108 06 58.0 4
BLUEWATER CREEK
35 7.5 PREWITT
T/BLUE WATER LAKE 120991
DRT RD BRDG 4 MI S RT 412 JCT
11EPALES 2111204
0000 FEET DEPTH, CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/12/07	13	10	0.016	1.600	0.020	0.017	0.020
75/01/19	11	45	0.028	0.100	0.008K	0.015	0.015
75/02/09	12	20	0.016	0.100	0.008K	0.015	0.020
75/03/21			0.020	1.850	0.030	0.005	0.040
75/04/08	12	35	0.030	0.750	0.030	0.030	0.100
75/04/29	11	15	0.005	1.200	0.020	0.015	0.050
75/05/22	14	45	0.020	2.100	0.030	0.025	0.110
75/05/31	14	40	0.005	0.600	0.020	0.020	0.040
75/06/07			0.005	0.425	0.025	0.010	0.020
75/07/27	11	50	0.020	0.300	0.055	0.010	0.050
75/08/29	13	50	0.010	0.250	0.020	0.010	0.010
75/09/14	12	45	0.015	0.700	0.220	0.010	0.030
75/10/18	11	30	0.005	0.100	0.010	0.010	0.030
75/11/15	12	30	0.005	0.200	0.005K	0.010	0.020

K VALUE KNOWN TO BE LESS THAN INDICATED

STORET RETRIEVAL DATE 76/12/16
NATL EUTROPHICATION SURVEY
EPA- LAS VEGAS

350281
35 20 30.0 108 12 43.0 4
COTTONWOOD CREEK
35 7.5 PINE CANYON
T/BLUE WATER LAKE 120991
SEC RD BRDG 1.8 MI NNW OF STALLINGS RNCH
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/12/07	14 00		0.008	0.400	0.040	0.005K	0.010K
75/04/08	12 00		0.130	1.450	0.075	0.030	0.250
75/04/29	10 50		0.005	1.650	0.025	0.020	0.040
75/05/22	13 20		0.020	1.750	0.020	0.005	0.200
75/05/31	14 10		0.005	0.350	0.020	0.005	0.030
75/11/15	12 00		0.005	0.200	0.005K	0.005K	0.020

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 76/12/16
NATL EUTROPHICATION SURVEY
EPA- LAS VEGAS

3502C1
35 18 45.0 108 10 00.0 4
UNNAMED STREAM
35 7.5 PINE CANYON
T/BLUE WATER LAKE 120991
SEC RD XING 2 MI ESE OF STALLINGS RANCH
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
75/03/21	11	05	0.010	1.600	0.055	0.025	0.050
75/04/08	12	15	0.010	1.100	0.085	0.035	0.040
75/06/07			0.010	0.900	0.035	0.010	0.060
75/08/29	14	10	0.005	0.350	0.015	0.005K	0.010

K VALUE KNOWN TO BE LESS
THAN INDICATED

APPENDIX E

PARAMETRIC RANKINGS OF LAKES SAMPLED BY NES IN 1975

STATE OF NEW MEXICO

Mean or median values for six of the key parameters evaluated in establishing the trophic conditions of New Mexico lakes sampled are presented to allow direct comparison of the ranking, by parameter, of each lake relative to the others. Median total phosphorus, median inorganic nitrogen and median dissolved orthophosphorus levels are expressed in mg/l. Chlorophyll a values are expressed in µg/l. To maintain consistent rank order with the preceding parameters, the mean Secchi disc depth, in inches, is subtracted from 500. Similarly, minimum dissolved oxygen values are subtracted from 15 to create table entries.

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500- MEAN SEC	MEAN CHLORA	15- MIN DO	MEDIAN DISS ORTHO P
0812	NAVAJO RESERVOIR	0.025	0.130	420.928	2.164	11.200	0.009
3501	ALAMOGORDO	0.025	0.050	469.667	5.867	10.600	0.003
3502	BLUE WATER LAKE	0.036	0.140	480.125	3.867	11.400	0.012
3503	CONCHAS RESERVOIR	0.020	0.040	451.833	3.275	14.400	0.004
3504	EAGLE NEST LAKE	0.181	0.070	455.750	13.357	14.400	0.132
3505	ELEPHANT BUTTE RESERVOIR	0.083	0.110	475.750	6.758	14.200	0.052
3506	EL VADO RESERVOIR	0.034	0.140	466.444	2.189	12.600	0.014
3507	LAKE MACMILLAN	0.097	0.045	489.778	14.133	10.100	0.009
3509	UTE RESERVOIR	0.021	0.040	448.750	3.242	13.800	0.004

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500- MEAN SEC	MEAN CHLORA	15- MIN DO	MEDIAN DISS ORTHO P
0812	NAVAJO RESERVOIR	63 (5)	25 (2)	100 (8)	100 (8)	75 (6)	56 (4)
3501	ALAMOGORDO	75 (6)	63 (5)	38 (3)	38 (3)	88 (7)	100 (8)
3502	BLUE WATER LAKE	38 (3)	6 (0)	13 (1)	50 (4)	63 (5)	38 (3)
3503	CONCHAS RESERVOIR	100 (8)	94 (7)	75 (6)	63 (5)	6 (0)	81 (6)
3504	EAGLE NEST LAKE	0 (0)	50 (4)	63 (5)	13 (1)	6 (0)	0 (0)
3505	ELEPHANT BUTTE RESERVOIR	25 (2)	38 (3)	25 (2)	25 (2)	25 (2)	13 (1)
3506	EL VADO RESERVOIR	50 (4)	6 (0)	50 (4)	88 (7)	50 (4)	25 (2)
3507	LAKE MACMILLAN	13 (1)	75 (6)	0 (0)	0 (0)	100 (8)	56 (4)
3509	UTE RESERVOIR	88 (7)	94 (7)	88 (7)	75 (6)	38 (3)	81 (6)